

Dorset Environmental Science Centre, Standard Operating Procedures:

Long-term Storage and Cataloguing of Benthic-Invertebrate Samples

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Last Revision Date: June 2011

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PIBS 8443e

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4 Disclaimer

Any reference to specific equipment, manufacturers, or supplies is for descriptive purposes only and does not constitute an endorsement of a particular product.

5 Introduction

The Biological-sample Archive at Dorset Catalogue (BADCat)¹ contains archive-related information for all benthic-invertebrate samples processed or stored at the Dorset Environmental Science Centre (DESC). This manual describes the standard operating procedures for archiving benthic-invertebrate samples at DESC; its purpose is to ensure that scientists, technicians and students archive biological samples correctly (Figure 1) so they can be effectively maintained and retrieved.

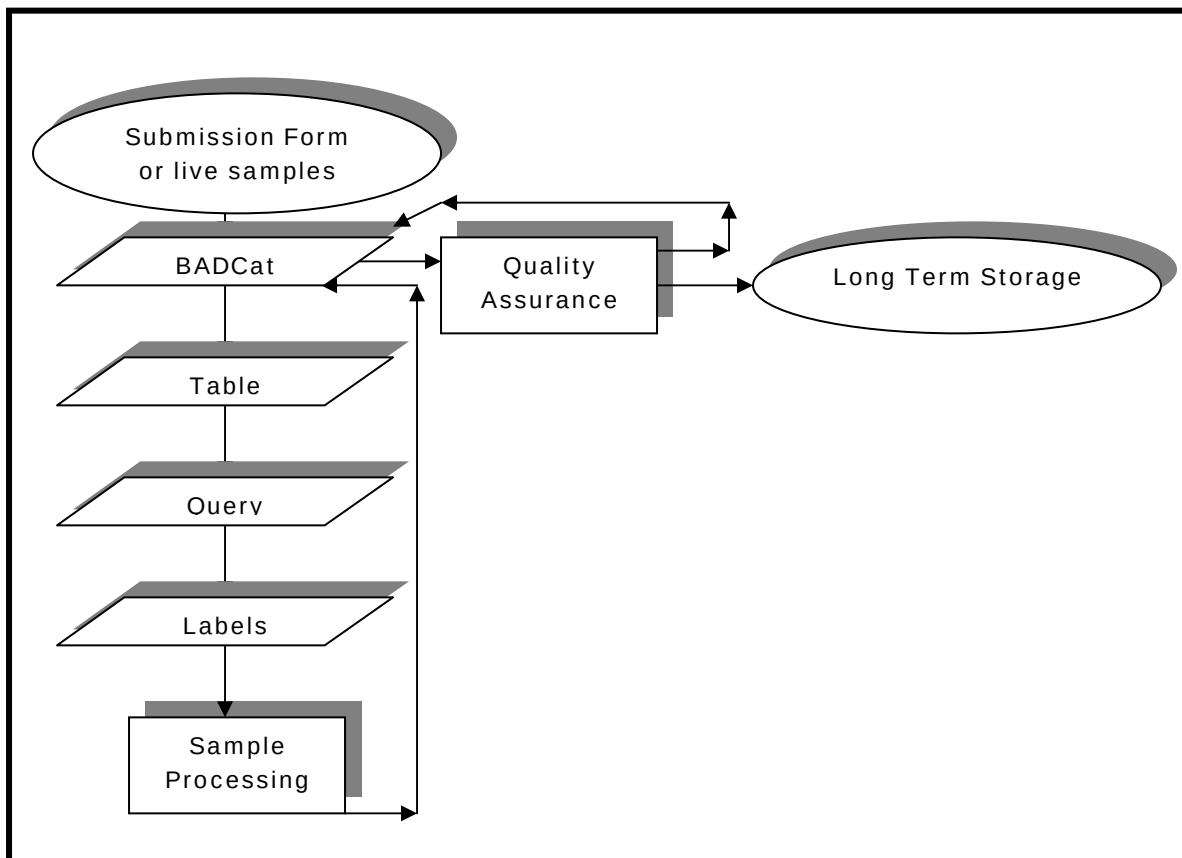


Figure 1. Sample management from submission to archiving.

5.1 Why Store Benthic-Invertebrate Samples?

Storing samples allows scientists to revisit samples and to make new observations or measurements, or to verify old ones. Storing samples permits future gathering of new data, even though the relevance of this data may not have been foreseen at the time samples were collected. Possible applications:

- o Identifying morphological deformities

¹ BADCat is currently stored on: *G:/Databases/BioDB/BADCat.mdb*.

- o Morphometric analyses
- o Isotope analyses
- o Contaminant analyses
- o DNA based taxonomic verification
- o Biomass calculations

Archived samples represent important records that substantiate published scientific articles.

5.2 Why use Standard Operating Procedures for Storing and Cataloguing Samples?

The standard operating procedure (SOP) for storing and cataloguing samples ensures that preserved samples can accurately and quickly be associated with the taxonomic-composition data upon which DESC benthic science is based. Furthermore, the SOP contributes to quality-assurance by ensuring consistency despite personnel turn-over. Benthic-invertebrates are preserved in ethanol, a volatile and highly flammable liquid. This SOP is important for safety reasons and reduces the risk of explosion and fire.

5.3 Current Holdings

DESC has over 14,000 samples stored in the BADCat database. The collection is from numerous Ontario lakes, streams and wetlands: 12,488 samples were collected through DESC's long-term lake and stream Rapid Bioassessment Program (Rapid Bio), and 2268 Ontario Benthos Biomonitoring Network (OBBN) samples were collected by OBBN network partners or for network-related research studies and others including: conservation authorities, parks, government agencies, non-government organizations, citizen-scientist volunteers.

6 Biological Sample Storage

6.1 Submission Form

Samples submitted from outside organizations are accompanied by a *Sample Submission Form* (Appendix 1). This form includes sample information required to enter data into BADCat. Samples are tracked through laboratory using the form until they are archived or returned to the owner.

6.2 BADCat

The BADCat is a catalogue of samples stored at DESC. The primary table, *Samples*, includes completion dates for various tasks, sample locations, contact information, taxonomic resolution and site descriptions associated with archived samples (Table 1). Each record is automatically assigned a unique number in the **Sample ID** field. The **Sample ID** prevents duplication and acts as the primary key to which other fields are joined. Once samples are catalogued in BADCat they are archived in the long term storage (LTS) building.

Table 1. The fields in the BADCat *Samples* table.

Field Name	Data Type	Description
Sample ID*	AutoNumber	A unique AutoNumber format identifier for each sample in the database
Agency*	Text	Owner of sample
Name	Text	Sample owner's name
Phone	Text	Sample owner's phone number
Description*	Text	Short site descriptor: water body name, location, study name.
Water Body Type	Text	Pick-list elements are: <u>Lake</u> , <u>Stream</u> or <u>Wetland</u>
Site Code New*	Text	A unique alphanumeric code to identify sampling sites
Replicate*	Text	Replicate or sample number
# of Vials*	Number	Number of vials
SDATE*	Date/Time [◇]	Sampling Date
Received	Date/Time	Date sample received at DESC
Processed	Date/Time	Date sample processed at DESC - if sent in a batch, enter the date when last sample was completed for the whole group
Taxonomy	Text	Pick-list elements are: <u>OBBN 27-group</u> , <u>Family</u> or <u>Lowest practical level</u>
QA Date	Date/Time	Date quality-assurance check completed
Archive Location	Text	Pick-list elements are: <u>DESC</u> or <u>Return to Owner</u>
Archive Date	Date/Time	Date sample archived in Long-term Storage building or returned to owner
Cabinet*	Number	Cabinet number in biological storage
Shelf*	Number	Shelf number in cabinet
Row*	Number	Row on cabinet shelf
Vial Return	Yes/No	Check Yes = Transport vials to be returned to partner; No = Vials to be re-used at DESC

[◇] Format is short date: mm/dd/yyyy. Type: Apr 2 09 and hit enter. Access will automatically convert the date to the appropriate format.

6.3 Long Term Storage Building

The LTS building, building #4, warehouses biological samples preserved in ethanol or formalin (Appendix 2). It was built in accordance with government regulations, including the Regulation for Industrial Establishments (R.R.O. 851/90) made under the Occupational Health and Safety Act of Ontario and the Ontario Fire Code (O. Reg. 388/97) made under the Fire Protection and Prevention Act. For safety reasons, it is an isolated building not attached or abutting any buildings occupied by personnel. This protects personnel in the event of a static-initiated fire or explosion.

Up to 235 litres of flammable liquid can be stored in the Biology lab in containers that are less than 23 litres each. Amounts that exceed 235 litres must be stored in a separate area (IAPA, 2008). Because large volumes are used at DESC, special storage rooms were built in the LTS building. These rooms house ethanol preserved samples (room 4a) formalin preserved samples (room 4b) and bulk ethanol, (room 4c). The rooms have features that allow storage of flammable liquids (Appendix 3):

- ◆ Blow-out walls that are designed to dissipate energy from an explosion while maintaining structural integrity.
- ◆ Concrete floors that reduce static electricity
- ◆ Double-egress doors that swing outward
- ◆ Exhaust fans to channel vapors to the outside (Figure 11)
- ◆ Temperature monitors with hot and cold temperature alarms
- ◆ Electrochemical sensor connected to a gas alert alarm (Figure 12)
- ◆ Explosion-proof, non-sparking fluorescent lights
- ◆ Explosion-proof, non-sparking convection heater (Figure 13)
- ◆ Floor drain in 4c
- ◆ No electrical outlets
- ◆ External and conduit wiring
- ◆ Fireproof metal cabinets that protect biological samples in room 4c (Figure 10)
- ◆ Copper grounding rail clamped to the ethanol drum in room 4c by a grounding cable

7 Procedures

7.1 Sample Acquisition

DESC receives live Rapid Bio samples or ethanol preserved samples from outside organizations.

7.1.1 Outside Organizations

1. Record the date the sample is received in ***Date Received by Lab*** on the *Sample Submission Form*.
2. Check for damaged containers and/or leakage. If either is present:
 - i. Bring samples to the lab and turn on the exhaust fans.
 - ii. Immediately transfer damaged containers samples to other containers and refill ethanol.
 - iii. Attempt to recover specimens.
 - iv. Top up leaking containers with ethanol and tighten lids.
 - v. Contact the sample owner and recommend proper packing techniques for future deliveries.
3. Verify all information on submission form is filled in correctly.
4. Verify that all samples correspond with the information on the form.
5. Keep the *Sample Submission Form* with its sample throughout the process.
6. Put samples in queue by entering sample information into BADCat.
7. Store samples temporarily in the lab until processing².
8. Enter sample information into BADCat to generate archive labels.
9. Process samples according to the OBBN protocol (Jones, 2007)

7.1.2 Rapid Bio

1. Enter sample information into BADCat³ to generate archive labels.
2. Process samples according to the DESC protocol (Solman, 2009)

7.2 **Data Entry**

7.2.1 Sample Location

The location of the samples in the LTS building is determined by the maximum number of glass archive vials (Figure 2) that can fit in one row, which is equal to one wooden storage caddy⁴ (Figure 3), then the number of rows that can fit on one shelf and then how many shelves are in one cabinet. Each sample is given a Cabinet-Shelf-Row number in the BADCat *Samples* table.

² Monitor the amount of ethanol in the lab and ensure it does not exceed the safe limit. Periodically move samples into the LTS building if there is an excessive amount of samples to process.

³ Because the Rapid Bio studies samples are live, records and labels are created and printed the same day samples are collected.

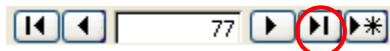
⁴ Instructions for making these storage caddies are in Appendix 4.



Figure 2. Borosilicate Glass Vial (Regina Industries Ltd).

1. Confirm that other database users have finished entering their data.
2. Open *BADCat.mdb*.
3. Select *Samples* table in the main BADCat window. Click on **Datasheet View** .

4. Go to the last record in the table. Use the navigation buttons at the bottom of the window. Click the **Last** button to move to the last record.



5. Start numbering the **Cabinet-Shelf-Row**⁵ from where the last record left off. Number each row until you reach 22 records. Then start a new row.
6. When you reach the 32nd row, start a new shelf and re-number the row from 1 until you reach the 32nd row on that shelf.
7. Fill all 11 shelves and start filling the next cabinet.

EXAMPLE: There are 15 samples with the same location: **Cabinet-5 Shelf- 2 Row- 32**. Add 6 more samples to make it equal 21-22 records in that row even if the samples are not from the same studies. The next batch of vials will have this location, **Cabinet-5 Shelf- 3 Row-1**.

⁵ The formula for sample storage: 21-22 vials - 32 caddies - 11 shelves may need to change if the dimensions of the caddy or the cabinets change.



Figure 3. Storage caddy with 21 archive vials.

EXCEPTION:

For ethanol preserved and sorted samples acquired from outside organizations, predict how the contents from those sample containers will transfer to a glass archive vial before processing them to family. Usually, the ratio is 1:1 and the **Cabinet-Shelf-Row** numbers can be added by following the previous steps. If the ratio is not 1:1 and one replicate has multiple vials put these in the storage caddy but **DO NOT** enter these vials as separate records in the *Samples* table. For example, there are 21 vials and two of those are multiple vials, enter 19 out of 21 records for that row in the *Samples* table. Only make reference to the multiple vials in the **# of Vials** field. Label the multiple vials accordingly (see Duplicate Labels).

7.2.2 Sample Information

1. While still in **Datasheet View** of the *Samples* table, go to the first record of the batch of samples previously entered.
2. Enter the information chronologically from the *Samples Submission Form* into the appropriate fields (Table 2).
3. Review the records to ensure that there are no errors.

Table 2. Map-over from the Samples Submission Form to Benthos Sample Storage Fields.

Samples Submission Form	Benthos Sample Storage Fields
Agency	Agency ⁶
Name	Name
Phone	Phone
Water Body Name	Description ⁷
Water Body Type	Water Body Type
Site Code	Site Code New
Sample	Replicate
# of Vials	# of Vials
Sample Date	SDATE
Date Received by Lab	Date Received ⁸

7.3 Vial Labels

Labels identify individual samples and describe sample locations in LTS. There are two types used, archive labels and temporary labels. They are generated and printed before samples are processed. The data associated with samples and the data recorded on the labels are a permanent record of research that is as important as the samples themselves.

7.3.1 Archive Label

Labels⁹ are generated from the records stored in the *Samples* table. Changes made in the table will be automatically updated in the labels. An internal label is laser-printed on waterproof or acid resistant paper. This label is put into a vial before any benthic-invertebrates are added to prevent damage to the soft bodied animals. An external label is printed on regular paper and affixed to the exterior of a vial using clear tape. The archive label is made in duplicate if there are multiple vials for a replicate. There are 4 steps for creating archive labels:

1. Make a query based on records in the *Samples* table.
2. Make a label report based on the preceding query.
3. Create duplicate labels (if needed).
4. Format and print labels.

⁶ **Agency** will be **DESC** for Rapid Bio studies, OBBN research studies will be **OBBN** and other studies will be the acronym of the organization.

⁷ Examples of Descriptions :

OBBN network studies can be descriptive or brief: Rocky Saugeen @ Con. 9, Glenelg Twp. or Dickie Lake @ Fluckers Bay or Campbell's Creek

For OBBN research studies always use a dash followed by the study name: Livingston Creek-Temporal Study

For Rapid Bio samples Rapid Bio (100 Animals): Harp Lake- Rapid Bio (100 Animals)

⁸ If processing live samples, enter the date the entire batch of samples is sorted.

⁹ Refer to the Rapid Bio or Temp Study label reports (correctly formatted) in the BADCat. Update the query information to reflect the new criteria.

7.3.2 Queries

1. Go to the queries tab in the main window of the *BADCat.mdb* and click on **New** and select **Simple Query Wizard**.
2. In the **Tables/Queries** dialog box, click on the table that will be used: *Samples*.
3. From the **Available** fields select the following:

- **Sample ID**
- **Agency**
- **Description**
- **SiteCodeNew**
- **Replicate**
- **SDate**
- **Cabinet**
- **Shelf**
- **Row**

5. Give the query a meaningful, descriptive name and open in

Design View .

6. Limit the records displayed in the query's results by specifying criteria. For example, under **Sample ID** criteria type an expression like: *Between 1256 And 1265*, to retrieve a batch of records.

7.3.3 Label Reports

1. Go to the reports tab in the main window and click on **New** and select **Label Wizard**
2. Select the query that the labels will be based on.
3. Select the product number C2160.
4. Select Arial font and size 7.
5. Set up label structure using a prototype label. Move field names into the prototype label as they will appear on the printed label, including the dashes between **Cabinet-Shelf-Row** (Figure 4).

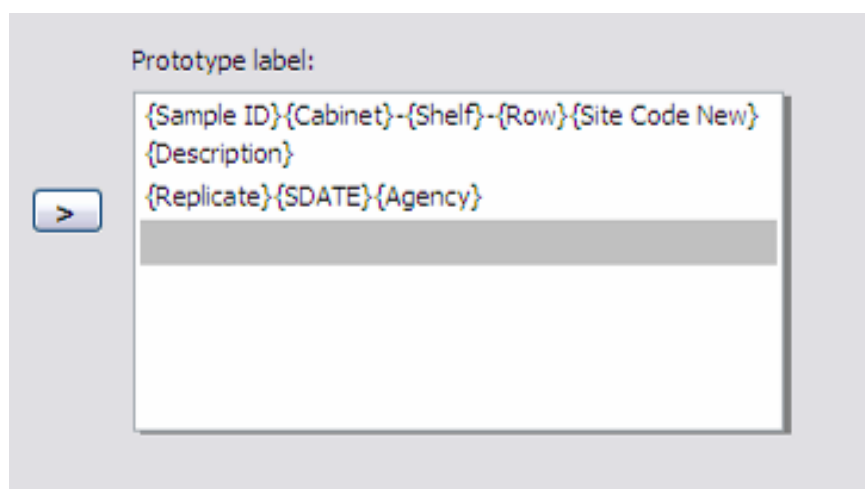


Figure 4. Prototype label.

6. Skip to the next question when prompted to sort the labels.
7. Give the label report a meaningful, descriptive name and open in **Design**

View.

7.3.4 Formatting Labels

1. Open the *Label Template-All Records* report in **Design View**.
2. Press **Ctrl+A** and copy the format from the *Label Template-All Records* report, including all text boxes and the black rectangle. Close this report.
3. Delete the text boxes in the active **Design View** and paste the format from the *Label Template-All Records* into the **Detail** section.
4. **Justify** the expressions in the text boxes until the text is aligned evenly along both the left and right margins of the rectangle (Figure 5). Switch to **Print Preview** to review the changes.

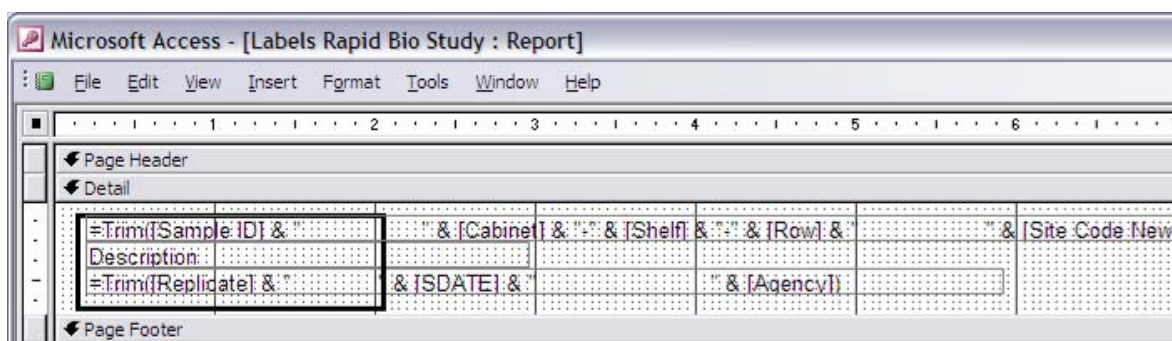


Figure 5. Design view of a label.

5. On the **File** menu, click **Page Setup** and then click on the **Page Margins** tab and change all values to 0.8 inches. Change the default values of the **Page**

Columns tab to the values shown in Table 3. Switch to **Print Preview** to review the changes¹⁰.

Table 3. Page setup for Columns.

Grid Settings	
# Columns	3
Row Spacing	0.0042"
Column Spacing	0.45"
Column Size	
Width	1.8" to 1.9"
Height	0.8347"

6. Decrease the footer space in **Design View** to maximize the number of labels you can print per page.
7. Abbreviate label information that is not contained within the rectangle in **Print View**.
 - a. Go to the *Samples* table and find the record that corresponds to the label that is overflowing.
 - b. Abbreviate nouns or adverbs in the **Description** field such as management to Mgmt. or road to Rd. or river to Rv., and upstream to U/S. If a place name is too long use an acronym.
8. Go to **Print View** to review the labels. The final labels should look like the label in Figure 6.

¹⁰ Guidelines only. The column width and spacing may need to be adjusted until three columns fit on the page.

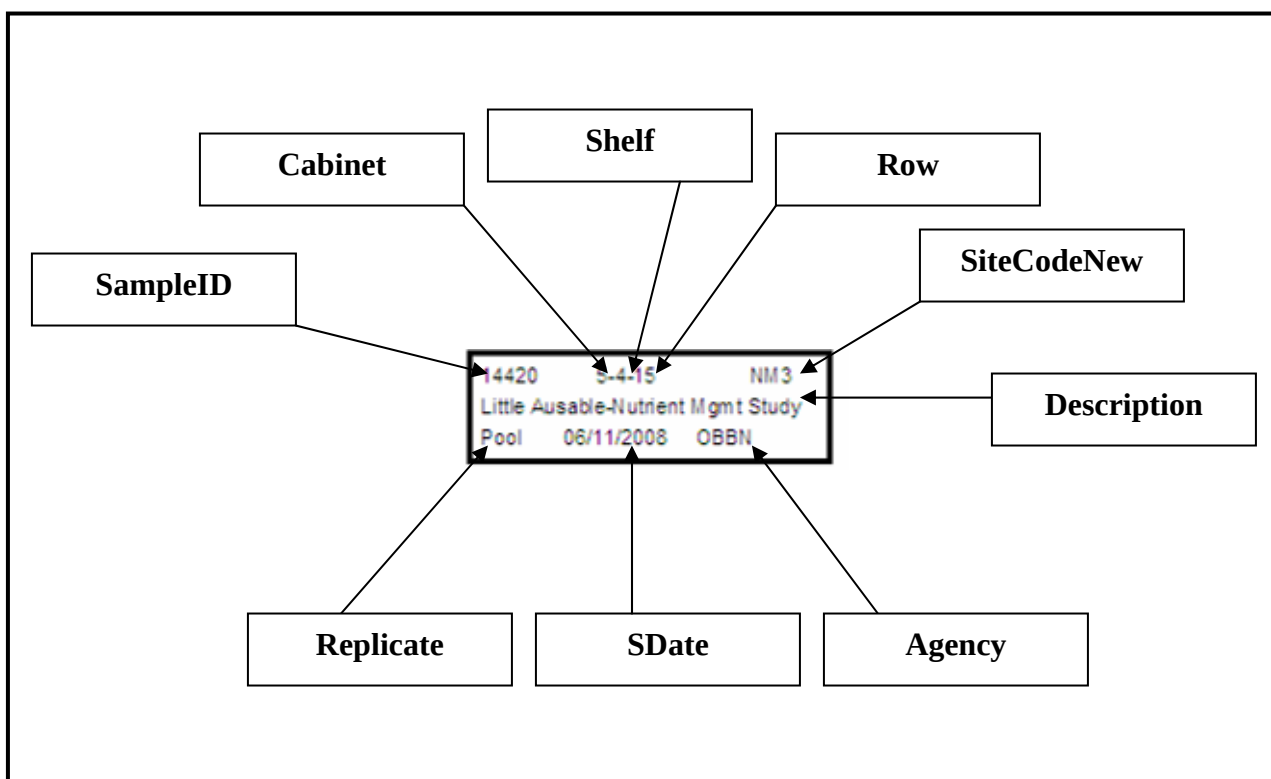


Figure 6. Formatted archive vial label.

9. Print the labels on regular paper first. Then print the labels again on waterproof paper. The waterproof labels are printed using manual feed. Feed each sheet separately into the machine to prevent the printer from picking up more than one sheet at a time.
10. Store unused labels in an expanding file folder. Organize the labels in the order they were queued in BADCat. Store smaller, cut-up labels in an envelope.

7.3.5 Duplicate Labels

Print off the same label for each multiple vial and handwrite an alphabetic character (A, B, C) on the internal and external label. Store the multiple vials next to the corresponding vial.

7.3.6 Temporary Labels

Temporary labels are neatly handwritten in pencil on waterproof paper and put into the glass archive vials. These labels include the basic information about the sample such as, site code, description, agency, sample date and replicate. They are only used for studies where the streams and dates sampled are unknown until sample collection is complete. These samples are then stored temporarily in the

lab until a quality-assurance check is completed. Once sampling is completed and all sample information is entered into BADCat laser printed archive labels are substituted in and on the vials.

7.4 Creating Storage Caddy Labels

Storage caddy labels are made and attached to a wooden storage caddy before it is filled with vials (**Error! Reference source not found.**). The label identifies the vials within the caddy as well as the row and shelf numbers.

1. Open the *Storage Caddy Label Template*¹¹:
2. Enter the range of **Sample ID** numbers contained within the caddy, the shelf and row number (Figure 7).

10601 to 10621
Row 6
Shelf 4

Figure 7. Caddy Label.

3. Print, cut-out and attach the label to one end of the caddy with an office stapler.

7.5 Sample Processing

Depending on the study, samples will be at different levels of processing. The samples can be ethanol preserved in the original sediment or live in the original sediment or preserved and sorted. Samples are sub-sampled according to either the OBBN method (F.C. Jones et al, 2007) or DESC method (S.M. David et al, 1998). Refer to the *Ontario Benthos Biomonitoring Network: Protocol Manual* when processing external samples. Refer to *Sampling Protocols for the Rapid Bio Assessment of Dorset Area Lakes and Streams using Benthic Macroinvertebrates* when processing DESC samples. In general, top up the vials with ethanol before capping the samples and place all the vials in order by **Sample ID** in the storage

¹¹ The *Storage Caddy Label Template* is currently stored: **G:\Programs\Benthos OBBN\OBBN Sample Processing\Storage Caddy Label Template.doc.**

caddy. In the BADCat *Samples* table, fill in date **Processed** and **Level of Taxonomy**¹² for each sample processed.

7.6 Quality Assurance

Currently, quality-assurance (QA) checks are completed on a random selection of samples by a peer confident in family ID or the scientist overseeing the program. In the near future these checks will be completed by North American Benthological Society (NABS) certified peer. Store samples temporarily in the lab until a QA check can be completed. Once completed, fill in the **QA Date** for each sample verified for family level ID and enumerations in the BADCat *Samples* table.

7.7 Sample Archiving

1. Check vials for evaporation. Make sure lids are tightly sealed and there are no cracks in the glass.
2. Make sure the storage caddy and vials are labelled correctly.
3. Archive the storage caddy in the LTS building in the correct **Cabinet-Shelf-Row**.
4. Fill in the remaining fields in the *Samples* table once samples are stored:
 - **Archive location**
 - **Archive Date**
 - **Vial Return**
5. Store *Sample Submission Form* in the appropriate filing cabinet.

7.8 Summary of the Storing and Cataloguing Procedures

1. Acquire samples and assess their general condition.
2. Enter sample information into applicable fields in the *Samples* table.
3. Define the sample location: **Cabinet-Shelf-Row** numbers.
4. Create labels using queries and label reports.
5. Identify and enumerate samples.
6. Create a storage caddy label and attach it to the caddy.
7. Complete a quality assurance check.
8. Fill in remaining fields in *Samples* table.
9. Archive samples in LTS building.

¹² **Level of Taxonomy** indicates whether a sample is done to order level, family level or more detailed. Update this field for each level achieved.

8 How to Find an Archived Sample

1. Create a query similar to a query for making labels.
2. Use the information known about the site(s) such as, site description, site code and date. Combine expressions or use them separately in the criteria row.
Examples of expressions that can be used:
 - o Use key words from **Description**: Like "Harp*"
 - o Use **Site Codes New**: "LeoL1"
 - o Use dates to find a group of samples from a specific time period:
Between #2005/05/16# And #2006/08/28#
3. Click on **Datasheet View** to acquire **Sample ID** and **Cabinet-Shelf-Row** numbers.
4. Retrieve the samples from the LTS building and return them .

9 References

David, S.M., K.M. Somers, R.A. Reid, R.J. Hall, and R.E. Girard. 1998. Sampling protocols for the rapid bioassessment of streams and lakes using benthic macroinvertebrates: second edition. Ontario Ministry of the Environment, Queens Printer for Ontario, Toronto.

Jones, F.C., K.M. Somers, B. Craig, and T.B. Reynoldson. 2007. Ontario Benthos Biomonitoring Network: Protocol Manual. Ontario Ministry of the Environment, Queens Printer for Ontario, Toronto.

Solman, N., F.C. Jones, R. Ingram, C. Thomson and R. Reid. 2009. Sampling protocols for the rapid bioassessment of Dorset area lakes and streams using benthic macroinvertebrates: third edition. Ontario Ministry of the Environment, Queens Printer for Ontario, Toronto.

Industrial Accident Prevention Association, 2008: *Flammable Liquids Storage* [Online] Accessed March 05, 2009: <http://www.iapa.ca/pdf/liquids.pdf>

Appendix 1 Submission Form

Sample Submission Form

To: Dorset Environmental Science Centre, 1026 Bellwood Acres Rd, PO Box 39 Dorset,
Ontario, P0A 1E0, Attn: OBBN Assistant Coordinator
Phone: 705-766-2412
Fax: 705-766-2254
E-mail: F.Chris.Jones@Ontario.ca

INSTRUCTIONS/DETAILS

- Samples should be sent in sturdy, well sealed containers, with sufficient packing materials.
- Samples should be free of most of the debris. Those with excessive debris will be sent back unprocessed.
- Use a pencil (not pen) to write on the labels or use adhesive laser-printed labels.
- Please specify a site code. A site code is a unique and descriptive code used to identify individual sampling sites. It can be a number or a combination of letters and numbers. The code will be used to track samples through the lab and once they are archived. It is also used in the OBBN database.

Example: Harlow Creek: Site Code: HAC01 OR Site Code: #155

- The following example illustrates how to complete the form:

#	Site Code	Sample	Water Body Name	Sample Date (mm/dd/yyyy)	Water Body Type (S, L or W) ¹³	Tally Sheet Sent		Field Sheet Sent		# of Vials
1	HAC01	1	Harlow Creek	05/12/2009	S	☒	N	☒	N	2
2	HAC01	2	Harlow Creek	05/12/2009	S	☒	N			1
3	HAC01	3	Harlow Creek	05/12/2009	S	☒	N			1

- Reference-site samples can be archived in our long-term storage in Dorset or we can return them (please indicate in comments section).
- Samples to be kept in Dorset will be transferred into our glass archive vials and are tracked in our biological sample database.
- As a minimum, we return a list of taxa (family and order level), our counts and your counts in a Microsoft Excel spreadsheet.
- As a result of the large number of samples sent to us, we often have a backlog. Expect a turn-around time of several months.

¹³ S = Stream L = Lake W = Wetland

Sample Information										
#	Site Code	Sample	Water Body Name	Sample Date (mm/dd/yyyy)	Water Body Type (S, L or W)	Tally Sheet Sent		Field Sheet Sent		# of Vials
1						Y	N	Y	N	
2						Y	N			
3						Y	N			
4						Y	N	Y	N	
5						Y	N			
6						Y	N			
7						Y	N	Y	N	
8						Y	N			
9						Y	N			
10						Y	N	Y	N	
11						Y	N			
12						Y	N			
13						Y	N	Y	N	
14						Y	N			
15						Y	N			
16						Y	N	Y	N	
17						Y	N			
18						Y	N			
19						Y	N	Y	N	
20						Y	N			
21						Y	N			
22						Y	N	Y	N	
23						Y	N			
24						Y	N			
25						Y	N	Y	N	
26						Y	N			
27						Y	N			
28						Y	N	Y	N	
29						Y	N			
30						Y	N			
31						Y	N	Y	N	
32						Y	N			
33						Y	N			
34						Y	N	Y	N	
35						Y	N			

#	Site Code	Sample	Water Body Name	Sample Date (mm/dd/yyyy)	Water Body Type (S, L or W)	Tally Sheet Sent		Field Sheet Sent		# of Vials
36						Y	N			
37						Y	N	Y	N	
38						Y	N			
39						Y	N			
40						Y	N	Y	N	
41						Y	N			
42						Y	N			
43						Y	N	Y	N	
44						Y	N			
45						Y	N			
46						Y	N	Y	N	
47						Y	N			
48						Y	N			
49						Y	N	Y	N	
50						Y	N			
51						Y	N			
52						Y	N	Y	N	
53						Y	N			
54						Y	N			
55						Y	N	Y	N	
56						Y	N			
57						Y	N			

Total # of Vials Sent: _____

Comments or Special Instruction	
Share data pertaining to these samples with other network members via the OBBN database: Y N	
Send samples back: Y N	
Send sampling containers back: Y N	
Date for data to be returned:	
Supplementary materials submitted (e.g. CD/DVD, report or photos):	

D.E.S.C. SITE MAP

1. PUMP HOUSE
2. SECURITY / FIRST AID
3a. EMERGENCY GENERATOR
3b. WATER TREATMENT
3c. CHLORINE TREATMENT - MAIN WATER SHUT-OFF
4. LONG TERM STORAGE
4a. ETHANOL PRESERVED SAMPLE STORAGE
4b. FORMALIN PRESERVED SAMPLE STORAGE
4c. ETHANOL STORAGE AND DISPENSING ROOM
4d. OUTBOARD MOTOR STORAGE
4e. PAINT STORAGE
4f. LONG TERM STORAGE 2ND FLOOR
5. GAS SHEDS
6. UNIVERSITY OF TORONTO
7. WATERLOO LABORATORY
9a. TRENT STORAGE
9b. PRIMARY POWER SHUT OFF (NORTH)
10. LUNCHROOM
11. UNIVERSITY OF WATERLOO
12. TRENT LABORATORY
13. PROPANE BULK STORAGE
13a. PROPANE - BULK STORAGE
13b. PROPANE - BULK STORAGE
13c. PROPANE - BULK STORAGE
14. FL A.M.S. LABORATORY
15. BIOGEOCHEMISTRY
16. MERCURY LABORATORY
17. BIOLOGY LABORATORY
18. CHEMISTRY LABORATORY
19. MAIN OFFICE
20. MAIN GARAGE
20a. PRIMARY POWER SHUT OFF (WEST)
21. BOAT STORAGE COMPOUND
21a. COVERED BOAT STORAGE
22. UTILITY STORAGE
24. METEOROLOGICAL SITE
25. WATER SUPPLY SHUT-OFF
26. WATER SUPPLY SHUT-OFF
27. PUMPING CHAMBERS
28. PUMPING CHAMBERS
29. SEPTIC TANK
A. LIQUID INDUSTRIAL WASTE TANK 1
B. LIQUID INDUSTRIAL WASTE TANK 2
C. LIQUID INDUSTRIAL WASTE TANK 3
D. LIQUID INDUSTRIAL WASTE TANK 4
E. LIQUID INDUSTRIAL WASTE TANK 5
F. LIQUID INDUSTRIAL WASTE TANK 6
G. LIQUID INDUSTRIAL WASTE TANK 7
H. ETHANOL SPILL CATCH TANK
P. PARKING

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E. LIQUID INDUSTRIAL WASTE TANK 5
F. LIQUID INDUSTRIAL WASTE TANK 6
G. LIQUID INDUSTRIAL WASTE TANK 7
H. ETHANOL SPILL CATCH TANK
P. PARKING

Appendix 3 LTS and Components of the Sample Storage Room



Figure 8. Long Term Storage Building



Figure 9. Storage Room 4a.



Figure 10. Metal Sample Storage Cabinet



Figure 11. Vent to outdoors.



Figure 12. Electrochemical Sensor, with a gas alert alarm.

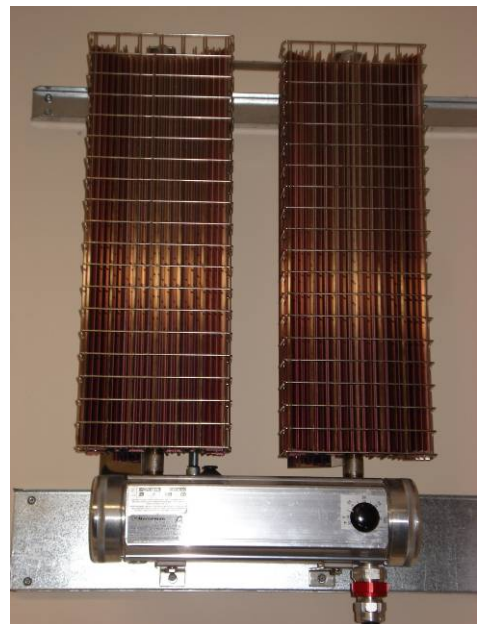


Figure 13. Explosion-Proof Heater.

Appendix 4 Building Storage Caddies

Storage caddies keep the archive vials organized in long-term storage cabinets. They are very simply constructed.

Materials

- 0.5cm plywood
- ¼” Staples
- Staple Gun
- Clear plastic on a roll that is 10cm high
- 1 1/2 cm finishing nails(12 per caddy)
- Wood glue
- Hammer
- Masking tape

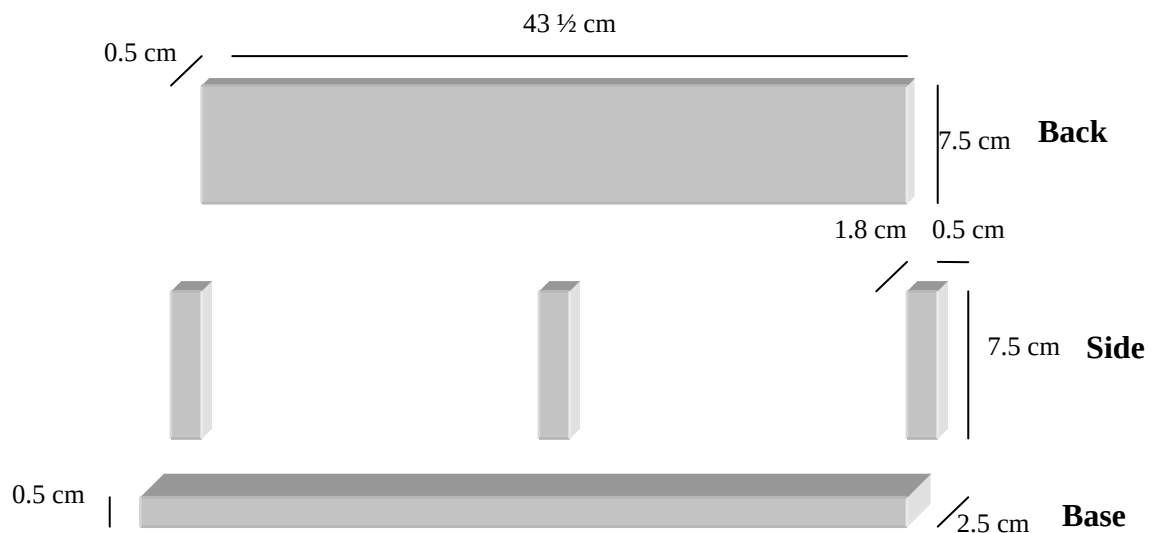


Figure 14. Diagram for a storage caddy [Not to Scale].

1. Cut plywood to the correct lengths.
2. Nail the frame of the storage caddy together.
3. Cut plastic strip to the length of the storage caddy. Temporarily attach this strip to the caddy using masking tape.
4. Cut any plastic protruding from the sides or the top of the caddy.
5. Staple the plastic onto the caddy with the staple gun.

